

CLAIMS

We claim:

1. A device comprising:
a positive electrode comprising a positive electrode material selected from the group consisting of a metal, a metal oxide, a hydrous metal oxide, semiconductor, alloys thereof, and mixtures thereof;
wherein the positive electrode is capable of storing and donating ions and electrons;
and
wherein the positive electrode is capable of reducing oxygen;
a negative electrode comprising a negative electrode material selected from the group consisting of a metal, a metal oxide, a hydrous metal oxide, semiconductor, alloys thereof, and mixtures thereof;
wherein the negative electrode material is different from the positive electrode material;
wherein the negative electrode is capable of storing and donating ions and electrons;
wherein the negative electrode is capable of oxidizing hydrogen; and
an electrolyte that permits transport of oxygen and hydrogen in contact with the positive electrode material and the negative electrode material.
2. The device of claim 1;
wherein the positive electrode material and the negative electrode material are capable of storing and donating protons; and
wherein the electrolyte is a proton-conducting electrolyte.
3. The device of claim 1, wherein the positive electrode material and negative electrode material have different thermodynamic potentials.
4. The device of claim 1, wherein the positive electrode material is coated on a conductive metal.
5. The device of claim 1, wherein the positive electrode material is coated on carbon.
6. The device of claim 1, wherein the positive electrode material comprises hydrous ruthenium oxide or hydrous iridium oxide.
7. The device of claim 6, wherein the hydrous ruthenium oxide is coated on a material selected from the group consisting of platinum metal, titanium metal, and carbon paper.

8. The device of claim 1, wherein the negative electrode material comprises platinum metal.
9. The device of claim 1, wherein the negative electrode material comprises an element selected from the group consisting of ruthenium, manganese, molybdenum, tungsten, platinum, gold, palladium, silver, titanium, copper, zinc, nickel, aluminum, gallium, germanium, arsenic, selenium, silicon, and phosphorous.
10. The device of claim 1, wherein the positive electrode, the negative electrode, or both are a hydrogen storage alloy.
11. The device of claim 1, wherein the electrolyte is aqueous.
12. The device of claim 1, wherein the electrolyte comprises sulfuric acid.
13. The device of claim 1, wherein the electrolyte comprises seawater.
14. The device of claim 1, wherein the electrolyte comprises tap water.
15. The device of claim 1, wherein the electrolyte is an oxide.
16. The device of claim 1, wherein the electrolyte is a polymer.
17. The device of claim 1, further comprising a source of oxygen and hydrogen.
18. The device of claim 1, wherein the electrolyte is exposed to ambient air.
19. The device of claim 1, wherein the positive electrode material and the negative electrode material are exposed to ambient air.
20. The device of claim 1, further comprising a substrate capable of converting water to oxygen and hydrogen when exposed to ambient energy.
21. The device of claim 20, wherein the ambient energy is selected from the group consisting of heat and light.
22. The device of claim 20, wherein the substrate is titanium foil.
23. The device of claim 20, wherein the substrate is the positive electrode, the negative electrode, or both.
24. The device of claim 1, wherein the device supplies power to one or more electronic devices.
25. A device comprising:
 - a positive electrode comprising hydrous ruthenium oxide coated on platinum metal;
 - a negative electrode comprising platinum metal; and
 - an electrolyte comprising dissolved oxygen and hydrogen in contact with the positive electrode and the negative electrode;
 - wherein the electrolyte is exposed to ambient air.

26. A method of harvesting energy comprising the steps of;
providing a device comprising:
a positive electrode comprising a positive electrode material selected from the group
consisting of a metal, a metal oxide, a hydrous metal oxide, semiconductor,
alloys thereof, and mixtures thereof;
wherein the positive electrode is capable of storing and donating ions and
electrons; and
wherein the positive electrode is capable of reducing oxygen;
a negative electrode comprising a negative electrode material selected from the group
consisting of a metal, a metal oxide, a hydrous metal oxide, semiconductor,
alloys thereof, and mixtures thereof;
wherein the negative electrode material is different from the positive electrode
material;
wherein the negative electrode is capable of storing and donating ions and
electrons;
wherein the negative electrode is capable of oxidizing hydrogen; and
an electrolyte that permits transport of oxygen and hydrogen in contact with the
positive electrode material and the negative electrode material;
allowing the device to charge; and
discharging the device.
27. The method of claim 26, wherein the allowing step and the discharging step are repeated one
or more times.
28. The method of claim 26, wherein the discharging step is performed such the rate of discharge
is approximately equal to the rate of charging.
29. The method of claim 26, wherein the allowing step and the discharging step are performed
simultaneously.
30. The method of claim 26, further comprising the step of:
transmitting the power generated in the discharging step to one or more electronic devices.
31. The method of claim 26;
wherein the positive electrode material and the negative electrode material are
capable of storing and donating protons; and

wherein the electrolyte is a proton-conducting electrolyte.

32. The method of claim 26, wherein the positive electrode material and negative electrode material have different thermodynamic potentials.
33. The method of claim 26, wherein the positive electrode material is coated on a conductive metal.
34. The method of claim 26, wherein the positive electrode material is coated on carbon.
35. The method of claim 26, wherein the positive electrode material comprises hydrous ruthenium oxide or hydrous iridium oxide.
36. The method of claim 35, wherein the hydrous ruthenium oxide is coated on a material selected from the group consisting of platinum metal, titanium metal, and carbon paper.
37. The method of claim 26, wherein the negative electrode material comprises platinum metal.
38. The method of claim 26, wherein the negative electrode material comprises an element selected from the group consisting of ruthenium, manganese, molybdenum, tungsten, platinum, gold, palladium, silver, titanium, copper, zinc, nickel, aluminum, gallium, germanium, arsenic, selenium, silicon, and phosphorous.
39. The method of claim 26, wherein the positive electrode, the negative electrode, or both are a hydrogen storage alloy.
40. The method of claim 26, wherein the electrolyte is aqueous.
41. The method of claim 26, wherein the electrolyte comprises sulfuric acid.
42. The method of claim 26, wherein the electrolyte comprises seawater.
43. The method of claim 26, wherein the electrolyte comprises tap water.
44. The method of claim 26, wherein the electrolyte is an oxide.
45. The method of claim 26, wherein the electrolyte is a polymer.
46. The method of claim 26, further comprising a source of oxygen and hydrogen.
47. The method of claim 26, wherein the electrolyte is exposed to ambient air.
48. The method of claim 26, wherein the positive electrode material and the negative electrode material are exposed to ambient air.
49. The method of claim 26, further comprising a substrate capable of converting water to oxygen and hydrogen when exposed to ambient energy.
50. The method of claim 49, wherein the ambient energy is selected from the group consisting of

heat and light.

51. The method of claim 49, wherein the substrate is titanium foil.
52. The method of claim 49, wherein the substrate is the positive electrode, the negative electrode, or both.
53. The method of claim 26, wherein the device supplies power to one or more electronic devices.